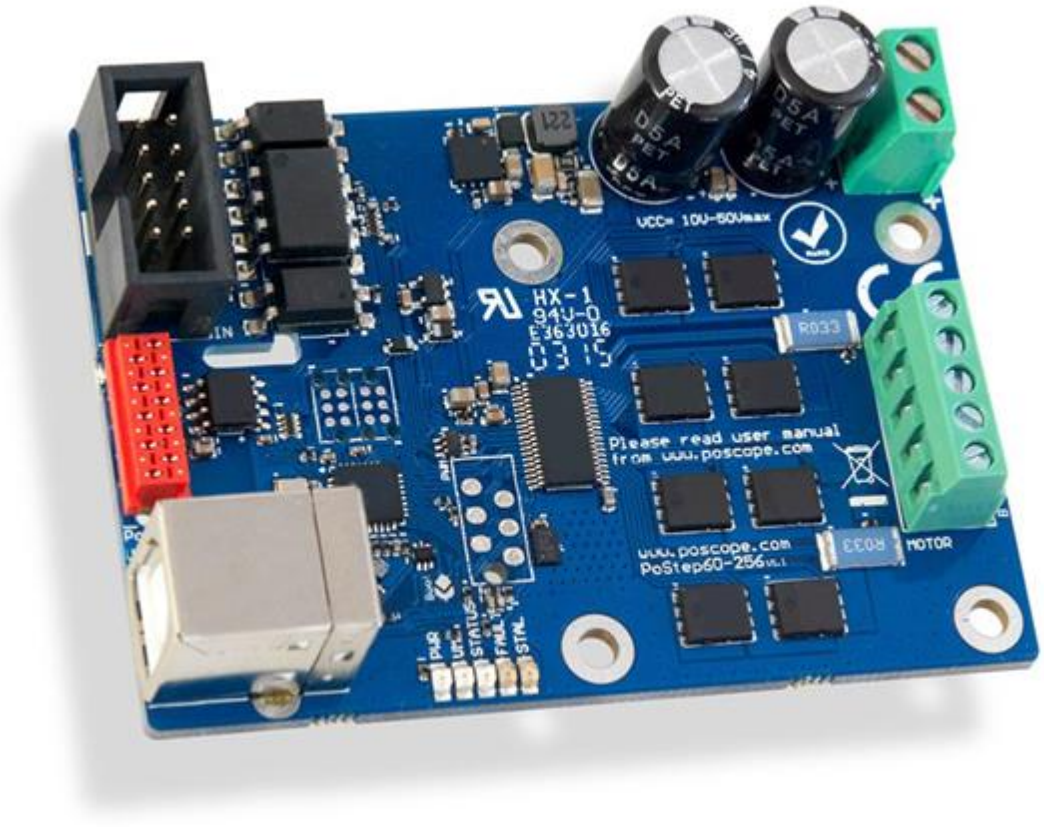
PoStep60

User manual

Version: 4/6/2015



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1 Introduction

This manual contains information required to configure over an USB and run the PoStep60 driver. Please read the manual carefully to avoid damage to the driver. This section covers the instrument general description, instrument specifications and characteristics.

1.1 General symbols for this instructions

A few symbols are used throughout this manual that you should be aware of in order to complete certain tasks safely and completely. These symbols have different degrees of importance as described below:

NOTE!

Tells you other important information.

CAUTION!

Tells you something that could be considered to reduce a risk of failure or malfunction.

WARNING!

Tells you something that could cause damage to a property.

2 Description

The PoStep60 driver incorporate advanced stepper motor controller and external N-channel MOSFETs to drive a bipolar stepper motor or two brushed DC motors. A micro-stepping indexer is integrated, which is capable of step modes from full step to 1/256-step. An ultra-smooth motion profile can be achieved using adaptive blanking time and various current decay modes, including an auto-mixed decay mode. A simple step/direction or PWM interface allows easy interfacing to controller circuits. An I2C serial interface can further be used to control all the driver functions including position control on board. All running parameters (output current (torque), micro stepping, step mode, decay mode...) can be set over USB and stored on board for standalone operation. Internal shutdown functions are provided for over current protection, short circuit protection, under voltage lockout and over temperature. Fault conditions are indicated via a FAULT LED, and each fault condition can be read in configuration software.

3 PoStep60 features

- up to 6,0 Amps Phase Current
- advanced settings available through USB connection
- compatible with 4, 6, and 8 wire stepper motors of any voltage
- +10 VDC to +50 VDC Power Supply
- up to 256 Micro-steps per Step
- various modes of decay mode for smoother moving of motors
- 3,3V and 5V logic compatible inputs
- 250 kHz Max Step Rate
- 0 °C To 85 °C Operating Temperature
- LED Power and Status Indicator
- Small Size: 54 mm X 75 mm

4 Connection diagram

4.1 Board use requirements

To properly operate the PoStep60 driver using external controller following connections need to be setup: step, direction and enable inputs; 10-50 VDC power supply, connected bipolar stepper motor before applying power.

CAUTION!

Please make sure bipolar stepper motor is connected before applying power.

4.2 Connection and setting

1. Mount PoStep60 driver firmly to a stable surface. If PoStep60 is mounted to a conductive (metal) surface, please make sure the driver is properly isolated.
2. Connect USB cable (1) to your PC and run PoStep user application
3. Please setup running parameters (output current (torque), micro stepping, step mode, decay mode...) using PoStep user application.
4. Connect step, direction, enable and GND from PoStep60 (2) to controller or BOB
5. Connect steeper motor (5) using one of wiring options bellow(
6. Connect power supply (4)

WARNING!

Please make sure power input polarity is correct. Double check before powering up the driver. Reverse power input polarity results in permanent device failure.

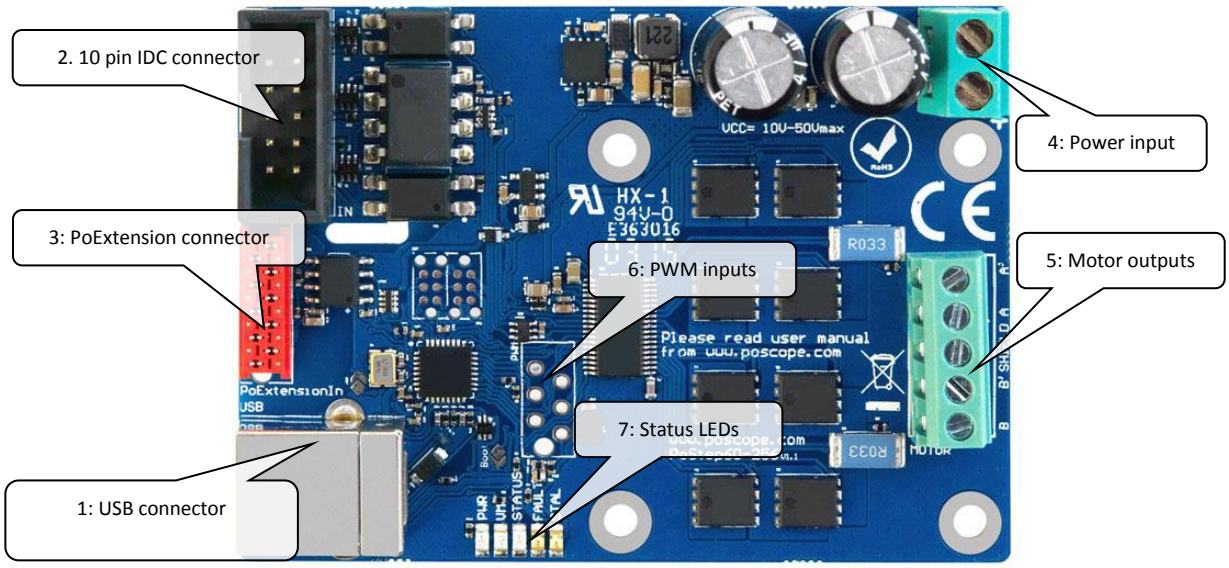
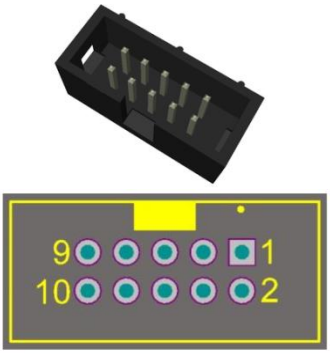


Figure 1: PoStep connections

4.3 Stepper motor connection

4.3.1 10 pin IDC connector pinout

Pin	Function
1	Enable (inverted, 0=enable, 1=disable)
3	Direction
5	Step
7	Fault feedback (OC, 1=driver OK, 0=fault detected)*
9	+5V external supply voltage
2, 4, 6, 8, 10	GND



*Fault feedback signal is an open-colector signal. External pull-up resistor is needed to function properly (please see Figure 2). For input and open-collector output limiting values please refer to Section 6 - Technical specifications.

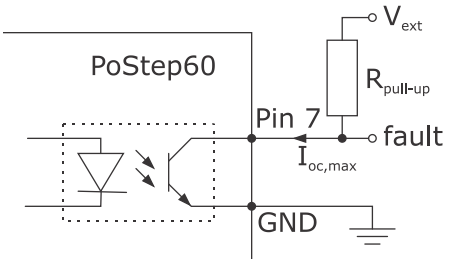


Figure 2: Fault feedback pin connection diagram

NOTE!

Please note some of the drivers are showing failed Under Voltage Lockout (UVLO) fault status when disabled and supply voltage within required limits. The fault is removed after driver is enabled and supply voltage within limits.

4.3.2 Stepper motor connections

CAUTION!

To avoid malfunctions please make sure the phase winds are connected correctly. Resistance between leads of different phases is usually > 100kΩ. Resistance between leads of the same phase is usually < 100Ω.

NOTE!

Simple method of finding correct pairs of each winding wires is as follows (before proceeding none of the motor wires should be connected): take two random wires and short circuit them. Try rotating the stepper axis. If the pair is matching the resistance while trying to rotate the motor is much higher comparing to when none of the wires is short circuited.

NOTE!

On the motor connector on the PoStep board there is a shield pin available (in the middle). Please use proper shielding techniques for best performance.

The drive will work with 4-wire, 6-wire or 8-wire stepper motors.

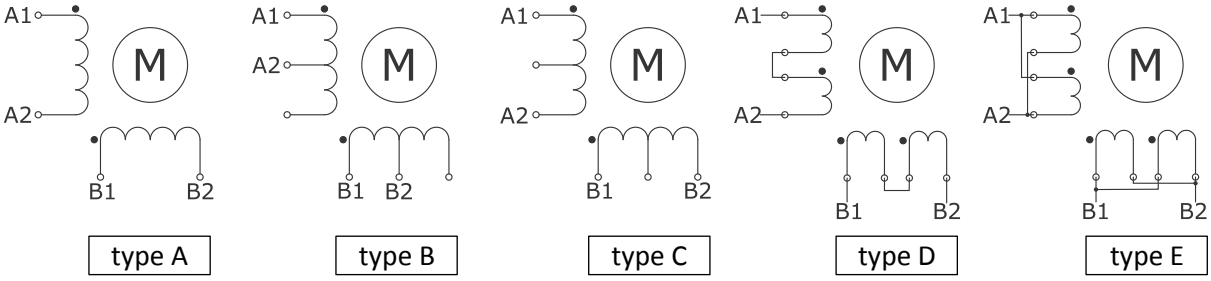


Figure 3: Stepper motor wiring options

4.3.2.1 4-wire motors (type A)

are truly bipolar, and can only be run as such.

4.3.2.2 6-wire motors

can be wired two ways to work with the bipolar drive.

The first is half-winding (type B): In this method, one end wire, and the center-tap wire of the phase is used. The other end is insulated and left unused. This method uses unipolar nameplate current specifications, and will produce nameplate torque.

The second is series winding (type C): In this configuration, the center-tap is insulated, and unused. This method uses all of the wiring per phase, but has double the number of wire turns as halfwinding or unipolar mode. Because of this, the amperage requirement becomes half the nameplate rating. Because the wire in the coil can handle more current than 'half', motor manufacturers will often "boost" the torque rating by specifying currents up to 71% of unipolar rated current while running in series mode. This is fine for FULL step motor drives, but not necessarily so good for microstepping drives. Using this much can smear microstepping smoothness and accuracy. Any extra torque achieved by this method will generally be lost to machine vibrations due to loss of microstepping smoothness. The best performance will be somewhere between the 50% and 71% current rating.

The advantage of using series winding is that lower power drives may be used. For example a unipolar motor rated for 4.0A/phase running in series requires only 2.0A/phase to achieve the same torque. The disadvantage of this method is that it raises motor inductance, which in turn, slows motor coil charging time. Since proper torque is reached only when the coil has charged to the required level, the longer it takes to charge, the longer until full torque is achieved. This leads to slower full torque stepping rates. Conversely, a half-winding configuration requires full nameplate rated current, but if the drive is capable of this, the advantage is that rated torque can be achieved twice as fast as series winding (using the same voltage, when comparing half-winding and series).

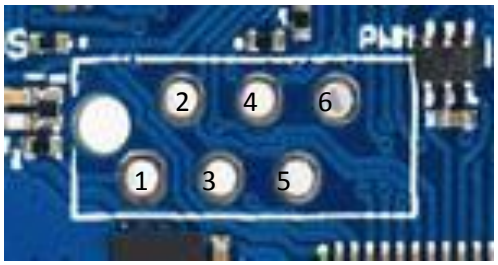
4.3.2.3 8-wire motors

can be run in paralell (type E) or serial (type D) mode. Parallel mode needs higher current, has lower inductance and better torque, Serial mode needs lower current and has lower torque. Please read also 6-wire motors.

4.4 DC motor connection

4.4.1 6 pin PWM connector pinout

Pin	Function
1	End Switch
2	PWM BIN2
3	PWM BIN1
4	PWM AIN2 (inverted)
5	PWM AIN1 (inverted)
6	GND



All PWM connector input pins has on board pull-up resistors. The pins can be either open-collector toward GND or push-pull driven. For input limiting values please refer to Section 6 - Technical specifications.

NOTE!

PWM AIN1 and PWM AIN2 inputs are inverted.

4.4.2 DC motor connection

The PoStep driver can be configured to enable direct control the state of the output drivers. This allows for driving up to two brushed DC motors. First DC motor is connected to terminals A1 and A2 and second DC motor to terminals B1 and B2. Speed and direction of DC motor rotation is controlled by PWM AINx and PWM BINx for first and second motor respectively. Driver allows connection of only one DC motor on A or B terminals as well as two DC motors.

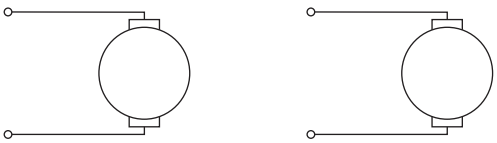


Figure 4: Connection of up to 2 DC motors

CAUTION!

Please make sure driver is configured to support DC motor drive. If not the DC motor can randomly rotate in speed and direction due to active micro stepping indexer.

NOTE!

Full-scale current value still apply when in DC drive mode. Idle current is not applicable and is not being used.

4.5 PoStep LEDs

There are five LEDs on the PoStep board showing status.

LED	Status
PWR	LED is on when PoStep is connected to a PC over USB or power supply is connected
VM	LED is on when power supply is connected
STATUS	Indicates various driver states
FAULT	LED is on when driver fault occurred. To see the fault cause the PoStep has to be connected to a PC and application running
STALL	LED is on when motor stall is detected in hardware.

4.5.1 Status LED

Status LED is used to indicate various PoStep driver states.

Pattern	Status
…….	LED is fast blinking when driver is in firmware update mode.
-.. -..	One long two short blinks indicates default settings are being loaded. Please use PoStep user application for proper configuration setup and store.
- -	Slow blinks indicate user configuration has been loaded

4.6 Requirements

- One available USB 1.1, USB 2.0, or USB 3.0 port
- USB HID device driver enabled operating system (Windows 98 SE/ME/2000/XP/Vista/7,8,10)
- Included software requires Windows 2000/XP/Vista/7,8,…
- Microsoft Visual C++ 2010 Redistributable Package (x86 or x64) or Microsoft Visual Studio 2010 needs to be installed on the system prior running PoStep60 application.

5 Installation

PoStep60 is USB HID compliant device and as such require no additional drivers for operation.

To operate the device user software installation is necessary on a target system.

NOTE! - The program can't start because MSVCR100.dll is missing from your computer.

If application fails to start showing above message most likely "Microsoft Visual C++ 2010 Redistributable Package" has to be downloaded from MS pages and installed prior running PoStep60 application.

NOTE! - The application was unable to start correctly (0xc000007b). Click OK to close the application.

If application fails to start showing 0xc000007b error please install **"Microsoft Visual C++ 2010 Redistributable Package (x86)"** no matter you have 64-bit MS Windows operating system running.

6 Technical specifications

6.1 Electrical specification – limiting values

Symbol	Parameter	Min	Max	Unit
V_M	power supply	-0.3	50	V
V_I	input voltage on 10 pin IDC input pins	-0.3	5.8	V
V_{ext}	supply voltage on pull-up resistor for fault signal	-0.3	50	V
$I_{oc,max}$	Fault signal maximum collector current		50	mA
$V_{DI,MAX}$	maximum voltage applied to PWM input pins		5.5	V
V_{iso}	isolation voltage (AC for 1min, R.H. 40-60%)		3000	V_{rms}
V_{esd}	electrostatic discharge	-4000	4000	V

6.2 Electrical specification – static characteristic

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{I, HIGH}$	applied voltage for HIGH state on 10 pin IDC input pins		3.0		5.8	V
$V_{I, LOW}$	applied voltage for LOW state on 10 pin IDC input pins				0.4	V
$V_{DI,HIGH}$	applied voltage for HIGH state on PWM pins		1.6			V
$V_{DI,LOW}$	applied voltage for LOW state on PWM pins				0.2	V

7 User application

User application enables various interactions with PoStep60 driver. The application enables setting of all the vital driver parameters including driver current (active, idle, and overheated values), micro-stepping value, driver name for later recognition, and advanced control setting values. Moreover, the application includes basic driving capabilities for stepper motors as well as two DC motors. For the stepper motor there is simple step/direction mode and more advanced onboard speed profile feature for out-of-the box drive of stepper motor. For DC motors drive there are two PWM channels with adjustable PWM values and directions. The application also monitors input statuses and driver status itself (temperature, mode, fault,…)

7.1 PoStep60 main application GUI

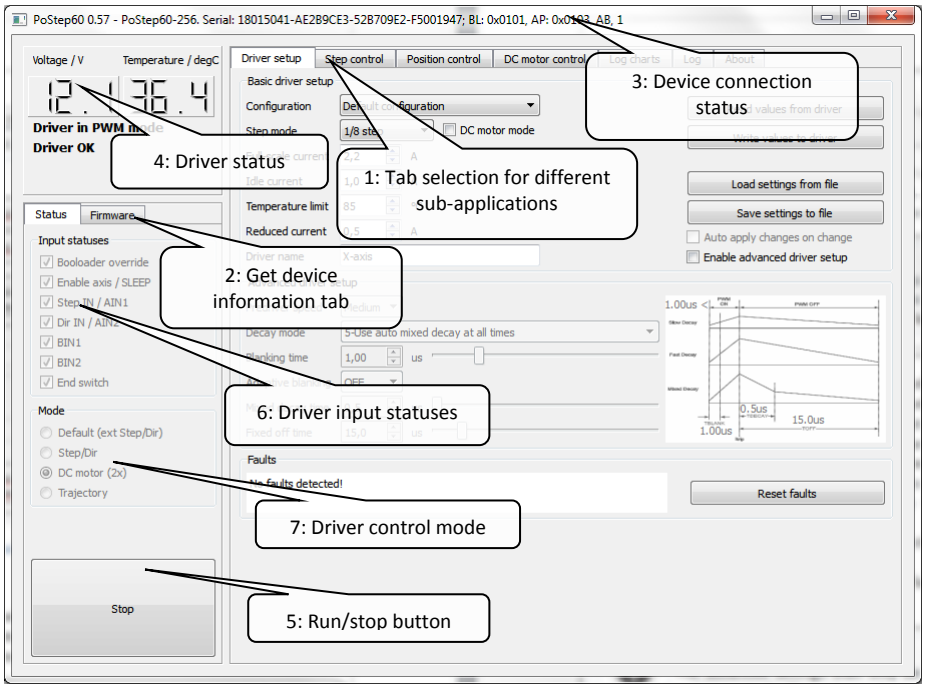

3: Device connection status
4: Driver status
1: Tab selection for different sub-applications
2: Get device information tab
6: Driver input statuses
7: Driver control mode
5: Run/stop button

Figure 5: PoStep60 main application GUI

Figure 5 notes:

1. Tab selection for different sub-applications – please use tabs to navigate between sub-applications
2. Click to get device information such as serial number, mode status, …
3. The application title bar displays connection status of PoStep device. If a device is connected a serial number is displayed and if not “not connected” message is displayed. Please note only one device at same time can be connected.
4. Driver status – The section displays real-time data of a driver connected if the driver is in application mode.
5. Stop/Run button disables and enables PoStep driver. Useful feature when in various control modes.

NOTE!

Please note enable signal is shared between external “Enable” input. Disconnected external signal when using application driver control features.

6. Driver input statuses displays current driver input statuses

7. Driver control mode displays current driver control mode

NOTE!

Driver real-time values are only available when driver is in application mode. In bootloader mode all driver features are disabled.

7.1.1 PoStep driver status

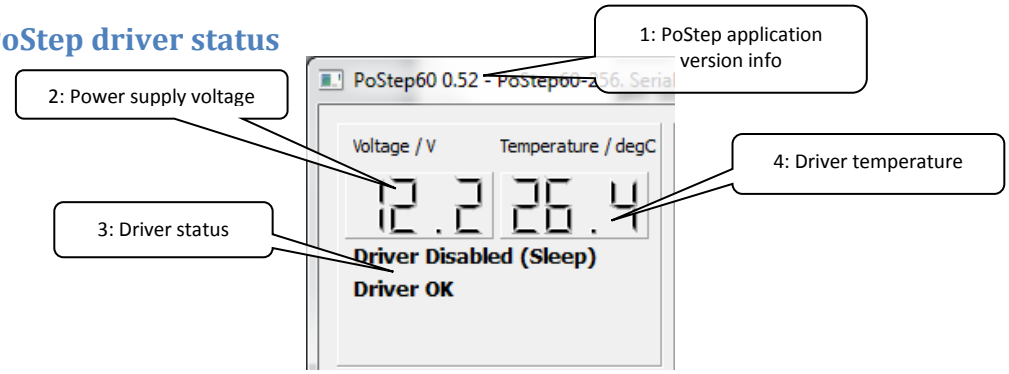


Figure 6: PoStep driver status section

Figure 6 notes:

1. PoStep application version info – please check for latest update of PoStep application.
2. Power supply voltage – displays main power supply voltage.
3. Driver status – displays driver statuses
4. Driver temperature – displays main power supply voltage.

CAUTION!

The displayed temperature value may differ from the actual driver temperature due to indirect contact. Parts of the diver can have higher temperature than one displayed and as such might cause you burns if touched.

7.1.1.1 Driver statuses

- Driver active – there was a signal change in step/direction inputs in the last 10 seconds. Full-scale active current value is set
- Idle – there was no change on step/direction inputs for more than 10 seconds. Idle current value is set
- Overheated – when driver exceeds limit temperature values drivers goes into overheated mode. Reduced current value is set
- Fault detected – displays that at least one of possible driver faults were detected. Please check fault type in Advanced settings.

7.1.1.2 Input statuses

The application shows real-time data of all the driver IO pins - Figure 7 (tick represents high level):

- Bootloader override – the pin should always be high
- Enable axis / SLEEP – high level enables diver operation. Low level puts the driver to sleep mode
- Step IN / AIN1 – this is Step input signal in stepper motor operation or Motor 1 PWM control AIN1 when in DC motor control mode
- Dir IN / AIN2 – this is Direction input signal in stepper motor operation or Motor 1 PWM control AIN2 when in DC motor control mode
- BIN1 – Motor 2 PWM control BIN1 when in DC motor control mode

- BIN2 – Motor 2 PWM control BIN2 when in DC motor control mode
- End switch – end switch input status

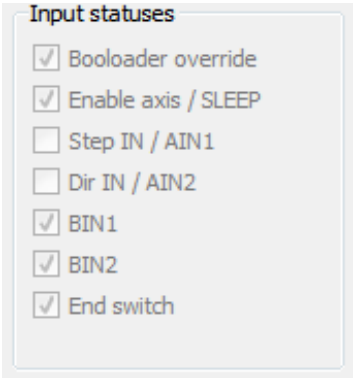


Figure 7: Input statuses

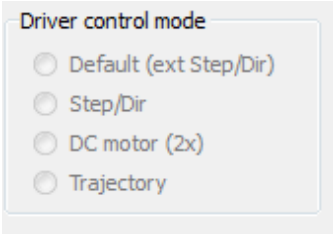


Figure 8: Driver control modes

7.1.1.3 Driver control modes

Driver control mode section displays current mode of the driver - Figure 8.

- Default (ext Step/Dir) – this is the driver default state which enables Step/direction control using external controller. Enable axis, Step IN, and Dir IN inputs shall all be connected for proper operation.
- Step/Dir – in this mode driver generates the driving signals. The mode is mainly used for driver settings adjustments – fine tuning. Please see subsection 7.4 Step control.
- DC motor – two DC motors can be controlled using direct PWM signals. Please see subsection 7.6 DC motor control.
- Trajectory – in this mode the driver take over controller parts of motion planning. Required position and speed profile parameters can be set. Please see subsection 7.5 Position control.

7.2 Basic user control of the PoStep driver

Basic user control section enables user selection of predefined driver configuration sets, setting currents: full scale, idle, overheated reduction, and temperature limit. Moreover, the basic manipulation with driver data is enabled: readout, change, and store. Furthermore, each of the drivers can be set an unique name for easier identification.

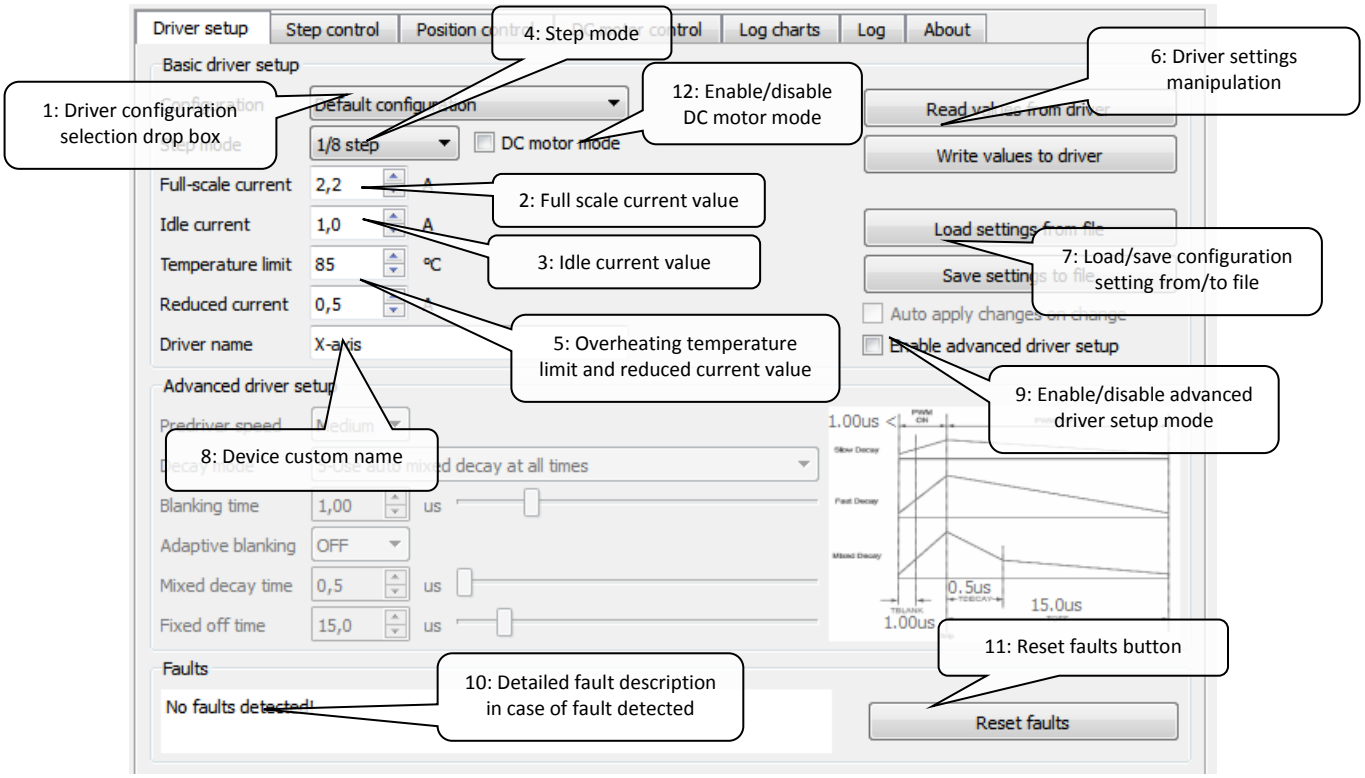


Figure 9: Basic user controls

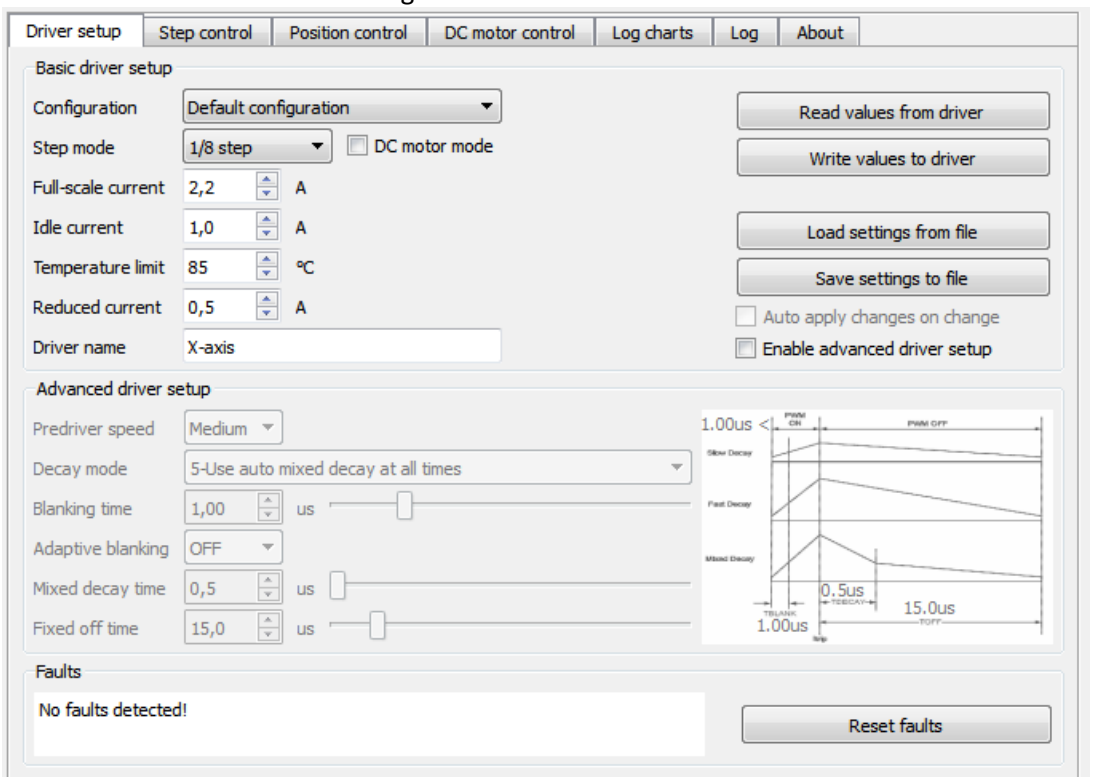


Figure 9 notes:

1. Driver configuration selection drop box – select one of predefined configurations. Use default configuration if you are not familiar with motor performance parameters.
2. Full scale current value – setup required motor current value.

NOTE!

Please follow stepper motor datasheet when setting driver values. Setting higher current value than nominal motor current may result in changed characteristics of PoStep motor driver (overheating, motor ringing,…) due to motor running out of specs.

3. Idle current value – setup idle current – idle current is a driver current when there is no activity on "Step/Dir" inputs for more than 10s.
4. Step mode – select a step mode between full step and 1/256-step (256 micro steps) mode.
5. Overheating temperature limit and reduced current value – setup a temperature limit at which driver reduces driver current to protect driver from possible overheating.
6. Driver settings manipulation – enables reading of actual driver configuration settings, configuration settings stored in non-volatile memory on driver, and confirm changes made
    a. Read actual settings – reads driver configuration settings currently set on the driver.
    b. Read stored settings – reads driver configuration settings stored in non-volatile memory on the driver.

NOTE!

Actual and stored settings may differ unless last changes had been saved to driver.

    c. Confirm changes – confirm and send changes in configuration settings to driver.
    d. Save settings to DRV – stores valid settings previously confirmed to a non-volatile memory on the driver. The settings are read and loaded each time driver is powered.

NOTE!

Any change in configuration settings made in application is not valid to driver until confirmed by "Confirm changes" as well as "Confirm changes" does not store the values to a non-volatile memory for loading on power cycle.

7. Setting files – enables loading/saving driver configuration settings from/to file
    a. Load settings from file – load driver configuration settings previously saved.
    b. Save settings to file – save currently set configuration to specified file.
8. Device custom name – displays or change driver custom name
    a. Read custom name – reads driver name
    b. Write custom name – writes and stores driver name
9. Enable/disable advanced driver setup mode – by checking advanced setup mode is enabled allowing setting advanced parameters
10. Detailed fault description in case of fault detected – further describes detected fault and possible cause of the fault
11. Reset faults – press the button to reset driver faults
12. DC motor mode – Enable or disable DC motor mode

7.3 Advanced settings

WARNING!

The advanced settings shall only be used by a person with a strong knowledge in motor control. There is a chance of setting combination that may results in permanent device failure.

In stepping motors, current regulation is used to vary the current in the two windings in a sinusoidal fashion to provide smooth motion. An ultra-smooth motion profile can be achieved using advanced settings such as blanking and decay time, and various current decay modes, including an auto-mixed decay mode.

The current through the motor windings is regulated by an adjustable fixed-off-time PWM current regulation circuit. When an H-bridge is enabled, current rises through the winding at a rate dependent on the DC voltage and inductance of the winding and the magnitude of the back EMF present. Once the current hits the current chopping threshold, the bridge disables the current for a fixed period of time, which is programmable between 500 nS and 128 us. After the off time expires, the bridge is re-enabled, starting another PWM cycle.

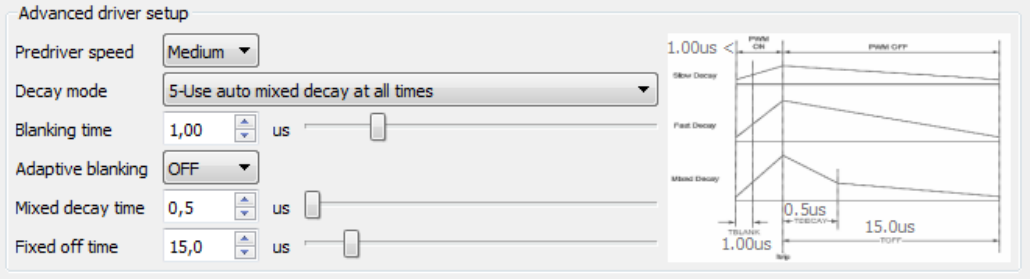


Figure 10: Advanced driver setup settings

NOTE!

When setting up the driver various compromises need to be considered such as:

- Higher the input voltage longer the fixed off time has to be to control the required current,
- Higher the input voltage lower the step mode,
- …

7.4 Step control

The application enables simple internal control of step/dir pins. It allows a test of basic driving capabilities of the PoStep60 driver.

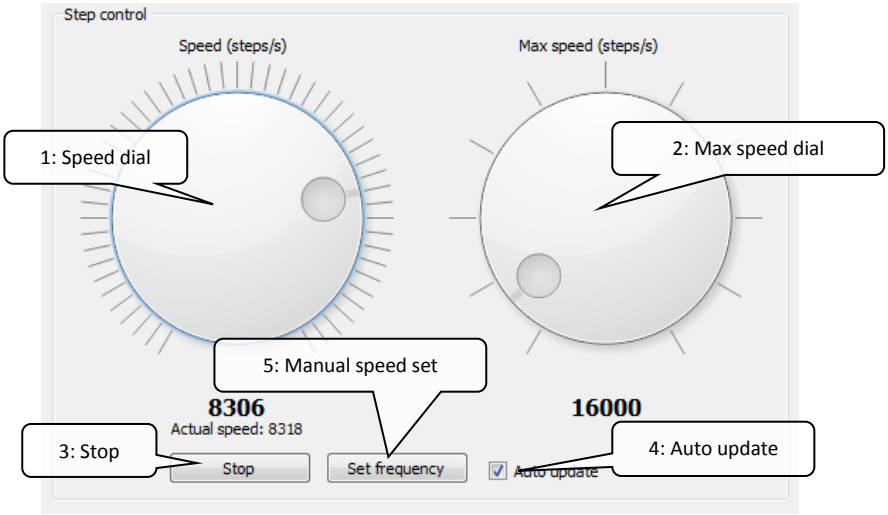


Figure 11: Step control controls

1. Speed dial – use this dial knob to set step speed. Please note the maximum value is limited by "Max speed" value.
2. Max speed dial – set maximum step speed to limit the step speed value set by "Speed" value.
3. Stop – stops internal step/dir generator and switch the pins control to external controller.
4. Auto update – if checked, any change in step speed value is sent to driver immediately.
5. Manual speed set – send new step speed value to driver if "Auto update" is disabled.
6.

NOTE!

If driver is used in combination with external controller or BOB please make sure to stop the application step/dir control by pressing button "Stop". This way external controller takes over control of the step/dir pins again.

7.5 Position control

Simple position control algorithm is implemented in the driver. The driver moves to required position using standard "Trapezoidal motion profile" where acceleration, deceleration, and maximal speed is defining the profile. Required position can be set using input box or slider. End switches (NC or NO; please note – end switch reacts only on change of end switch state.) and position limits can be used to define/limit a range of movement. The provided position control allows a test of basic driving capabilities of the PoStep60 driver and is not intended to replace external controller.

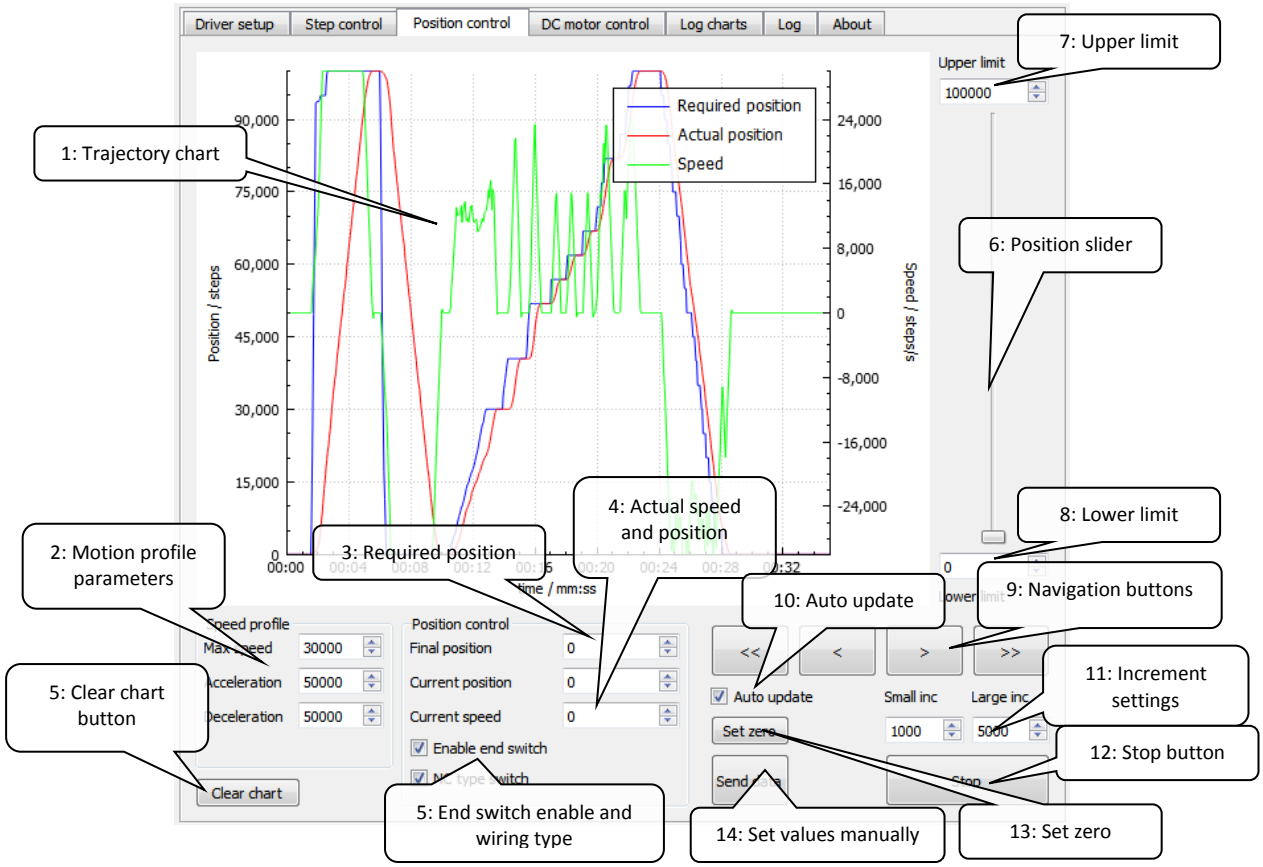


Figure 12: Position control controls

1. Trajectory chart – displays required and actual position and speed charts
2. Motion profile parameters – Trapezoidal motion profile parameters: acceleration, deceleration, and maximum speed
3. Required position – set and displays (slider) required position
4. Actual speed and position – displays actual speed and position values
5. End switch – enable/disable end switch control and end switch wiring type settings

NOTE!

End switch reacts only on change of end switch state. Position change request after end switch touched can be set in either direction.

6. Position slider – required position can be set using slider
7. Upper limit – limits final position.

NOTE!

If current position is out of new position limit values set then required position will adjust accordingly and motor shall move if Auto update is enabled.

8. Lower limit – limits starting position
9. Navigation buttons – set required position by a step defined by increment settings (11)
10. Auto update – send new values to driver automatically if checked
11. Increment settings – defines Small and Large increments for navigation steps

12. Stop button – stops position movement immediately (no deceleration profile applied)

NOTE!

If driver is used in combination with external controller or BOB please make sure to stop the application Position control control by pressing button “Stop”. This way external controller takes over control of the step/dir pins again.

13. Set zero – set both the required and actual position values to zero
14. Set values manually – send new values to driver manually

7.6 DC motor control

PoStep60 driver can be configured to drive up to two dc motors bi-directionally. Enabling DC motor control bypass driver internal indexer control used for stepper motor micro-stepping control. All the driver parameters except idle current apply for DC motor control as well. This enable current limited DC motor drive using PWM control. The PoStep60 application enables simple PWM control where PWM and PWM frequency (period) can be set.

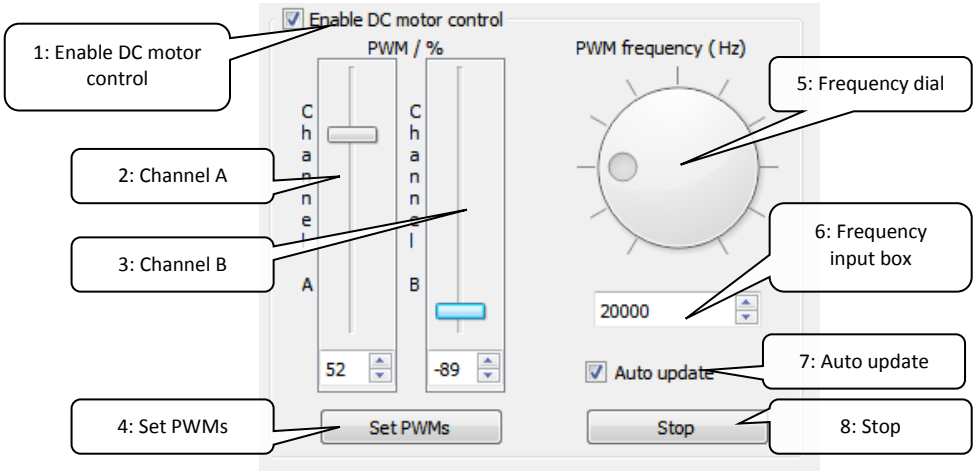


Figure 13: DC motor control controls

1. Enable DC motor control – enables and disables DC motor control.

NOTE!

Enabling or disabling DC motor control puts driver into stand-by to prevent sudden movement of motor or accidental overheating of stepped motor winding.

2. Channel A – Slider and input box for PWM value for DC motor connected to output terminals A
3. Channel B – Slider and input box for PWM value for DC motor connected to output terminals B
4. Set PWMs – send new values to driver manually
5. Frequency dial – set PWM frequency (period)
6. Frequency input box – set PWM frequency (period)
7. Auto update – send new values to driver automatically if checked
8. Stop – sets PWMs to zero and put open collector inputs to high state enabling external PWM controller PWM control

NOTE!

If driver is used in combination with external controller or BOB please make sure to zero PWM values by pressing button “Stop”. This way external controller takes over control of the PWM inputs again.

7.7 Log charts

PoStep60 application enables simple log of major driver parameter through time. By the chart the driver temperature can be monitored for possible overheating. This way driver setting can be adjusted or heat dissipation elements checked for its performance.

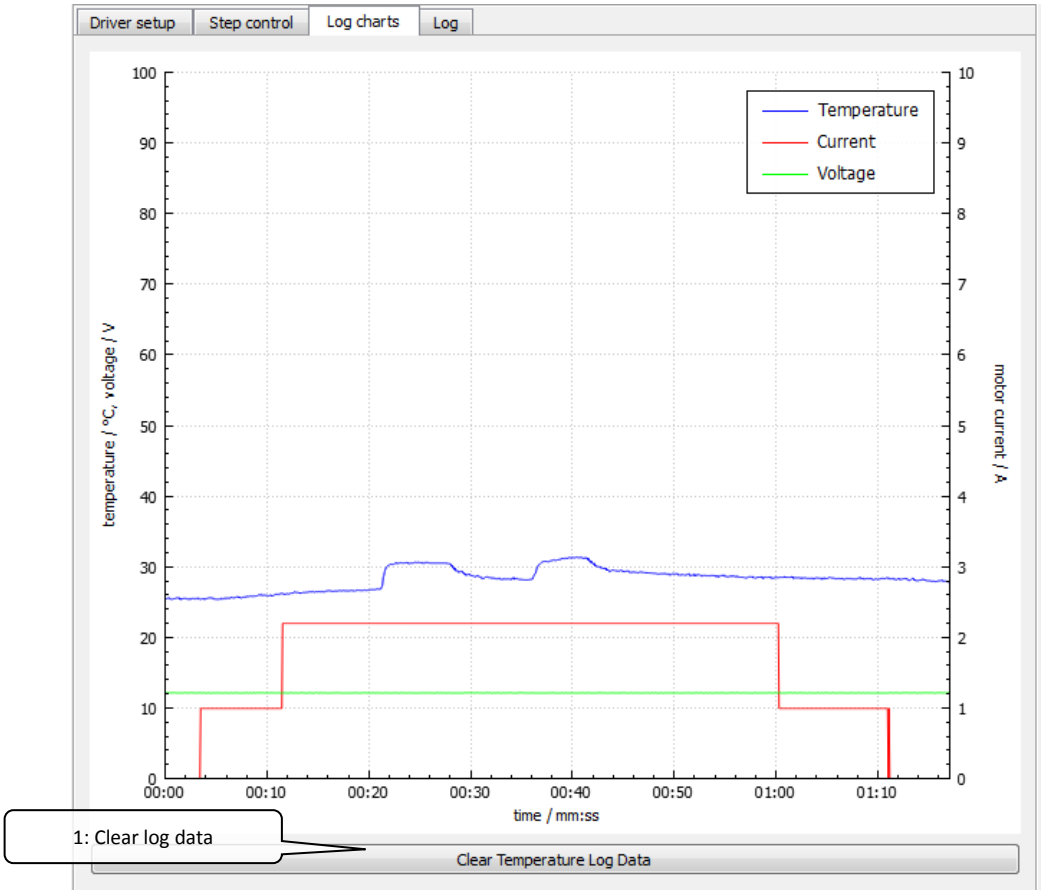


Figure 14: PoStep60 driver parameters log chart

1. Clear log data – Clears log charts data.

7.8 Firmware update

Application automatically checks for PoStep60 driver firmware version and advises when update needed. If by any chance automatic firmware update fails a manual update is possible. Please select "Firmware" tab and manually reset PoStep60driver to enter boot mode ie. when "Full update" button is enabled. Trigger update by pressing "Full update" and wait for finished update. After update the driver automatically resets and enters normal mode.

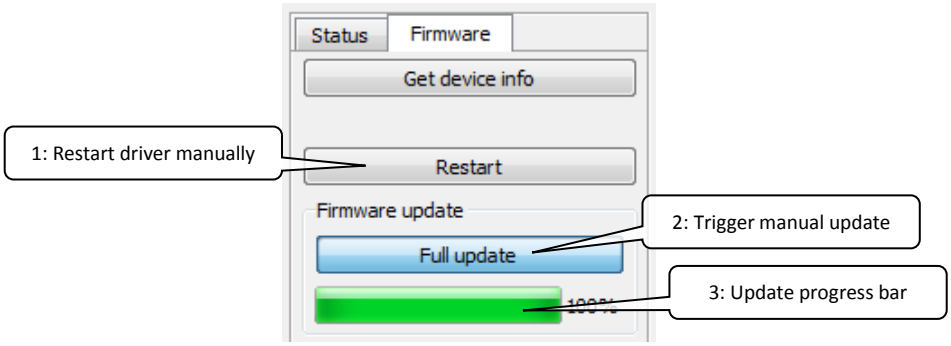


Figure 15: Manual firmware update

1. Restart driver manually – trigger driver restart and enables the driver to enter boot mode.
2. Full update – trigger start of full firmware update
3. Update progress bar – shows status of update progress.

7.9 Major changes from 0.53 to 0.57:

- Predriver Fault bug fix
- Position control added
- DC motor mode setting added
- DC motor control added
- Improved Voltage and Temperature filtering
- Added installation notes (MS VS 2010 redistributable package)

7.10 Errata information

Predriver Fault bug causing faulty driver failure status. Driver update is need to a software version 0x0103 or above.

Affected: All drivers with a software version bellow 0x0103.

7.11 User manual changes

Changes in 2/6/2015 version:

- 10 pin IDC connection diagram updated
- PWM input pinout description and note updated
- Technical specifications section updated

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